

SPECIAL CONTRIBUTIONS.

THE THUNDERSTORM OF SEPTEMBER 17-18, 1895.

By ALFRED J. HENRY.

In September, 1895, I had occasion to trace the progress of the front of a thunderstorm across the country by means of the pressure oscillations as given by the barographs at stations in the storm track. The particularly interesting feature of that storm was the fact that it preserved its vigor during the night hours, and was curiously deflected southward on reaching central New York. Copies of some of the barograph traces illustrating the advance of this storm are given on Chart XI. By combining the observations at voluntary with those at regular stations, I have been able to draw approximate isobronts, as shown on Chart XII a.

Attention is called particularly to the rapidity of motion along the axis of the lower lakes, as compared with adjacent land areas. The line of thunderstorms was deflected south-eastward after reaching central New York, but does not seem to have extended to Norfolk, Va. Rain fell in southern New England during the forenoon of the 18th, the conditions which produced the fall apparently advancing from the westward in the line of the original thunderstorm disturbance.

Copies of extracts from the daily journals are given in the following appendix for Weather Bureau stations in the line of progress of the general thunderstorm disturbance:

EXTRACTS FROM THE DAILY JOURNALS FOR SEPTEMBER 17-18, 1895, AT STATIONS NAMED.

Marquette, Mich., 17th.—Clear until 9:30, when clouds increased until the sky was cloudy; light rain began 3:35 p. m. ending 5:38 p. m.; thunderstorm; first thunder heard at 5:05 p. m.; loudest, 5:20 p. m., and last 10:34 p. m.; storm came from the southwest, and moved toward the east-northeast; temperature before the storm, 56°; after, —; direction of the wind before the storm, east; after, —; thunder was heard until 7:58 p. m. as distant rumbles, it then grew louder with bright flashes of lightning in northwest, north, northeast, and east; light rain began, 7:55 p. m.; ending 10 p. m.

18th.—Fair at times during the morning; partly cloudy to clear in the afternoon.

Sault Ste. Marie, Mich., 17th.—Clear during forenoon, becoming cloudy toward evening; light rain began 7:24 p. m., continuing at midnight; much colder all day; rising barometer until noon, then falling sharply and fluctuating considerably between 6 p. m. and midnight; light to fresh variable winds, principally from northwest to northeast until 1:30 p. m., then becoming southwest to southeast; brisk southeast winds began at 10:30 p. m.

18th.—Light, drizzling rain continued from midnight till 10:35 a. m.; cloudy the remainder of the day, with a light sprinkle from 4:10 to 4:25 p. m.; slightly cooler, with low barometer, rising slowly after noon; brisk southeast winds during night becoming light toward noon; at 2 p. m. wind veered to northwest, increasing to brisk and decreasing suddenly to light at 8:30 p. m.; at 10 p. m. fresh southeast wind began.

Green Bay, Wis., 17th.—Thunderstorm; first heard, 3:55 p. m.; loudest, 4:30 p. m.; last, 5:15 p. m.; storm came from the southwest and moved toward the northeast; temperature before the storm, 66°; after, 66°; direction of the wind before the storm, northeast; after, northeast; light rain began 3:45 p. m., ended 5:30 p. m.; partly cloudy, cooler weather, rapidly falling barometer, fresh variable winds; distant sheet lightning observed in the north at 8:20 p. m.

18th.—Cloudy weather during morning; clear during afternoon; warmer; rising barometer; fresh westerly winds.

Milwaukee, Wis., 17th.—Ordered to hoist easterly information signal 4:30 p. m.; received at 5 p. m.; thunderstorm, only one peal of thunder was heard and that occurred at 5:10 p. m.; storm came from the south and moved toward the northeast; temperature before, 62°; after, 61°; direction of wind before, east; after, southeast; rain began at 5:10 p. m. and ended at 5:35 p. m.; amount, 0.02 inch; order to hoist southeast storm signals 10:15 p. m.; was received at 10:45 p. m.; brisk easterly winds to high westerly; maximum velocity, 25 miles southwest at 11:40 p. m.; rapidly falling barometer and much higher temperature during the evening and night.

18th.—Order to lower signals 10:30 a. m. was received at 10:55 a. m.; much lower barometer and slightly warmer; high westerly winds shifting to easterly and decreasing in force; maximum velocity, 26 miles southwest at 3:10 a. m.; dense fog set in at 5:30 p. m. and contin-

ued until 11:30 p. m., after which time it became light; it disappeared entirely about midnight.

Chicago, Ill., 17th.—Clear all day; warmer; variable winds; hoist easterly information signal at 4:30 p. m.; changed to storm southeast at 10 p. m.

18th.—Mostly clear in forenoon; continued warm, high westerly winds, increasing in force, maximum velocity 40 miles from the southwest; signals down at 10 a. m.

Grand Haven, Mich., 17th.—Dense fog continued through the night, lifting at 10 a. m.; fog deposit to the amount of .02 inch was recorded; barometer began to fall rapidly at midday with partly cloudy weather becoming cloudy and threatening in the evening, with a light thunderstorm; light sprinkling rain from 6:55 to 7:35 p. m.; first thunder heard 5:58 p. m.; loudest, 6:55; last, 7:25 p. m.; storm moved from west to east; temperature before storm, 79°; after, 72°; wind before storm, southwest; after, southeast; wind increased from the southeast during the night and veered to southwest at 11:15.

18th.—High southwesterly winds in the early morning diminishing toward daylight and veering to northwesterly; cloudy in the morning, followed by a dense fog from 9:30 to 11 a. m.; fog deposit, trace; clear in the afternoon and at night.

Alpena, Mich., 17th.—Light rain began at 7:30 p. m. ended at 8:35 p. m.; thunderstorm began at 10 p. m.; loudest, 11:35 p. m., and continued; storm moved from west to east; direction of wind before, southeast; during, southeast, east, northwest, north, and northeast; temperature before, 58°; heavy shower of rain began 10:50 p. m. and continued; hoist easterly information 4:30 p. m.; received 6 p. m.; hoist storm southeast 10:15 p. m.; received 11:25 p. m., gale began 11:50 p. m. and continued; very sudden and rapid changes in atmospheric pressure occurred between 9:30 p. m. and midnight, accompanied by decided rises and fall of the water in Thunder Bay and Thunder Bay River; from about 9:30 p. m. to about 10:30 p. m. the barometer fell from 29.17 to 29.01 when it rapidly rose to 29.22 apparently in about five minutes, and then fell to 29.15 a little after 11:40 p. m.; at midnight it had fallen to 29.08 and was still falling.

18th.—Thunderstorm ended 12:30 a. m.; direction of wind after, southeast and east; temperature after, 53°; rain ended during night; winds shifted to northwest at 10 a. m.; gale attained its height 12:20 a. m., 35 miles southeast; ended 1 a. m.; special observation 2:30 p. m. * * * Slightly warmer, cloudy, and threatening up to 4 p. m., when clouds began to break away; between 8:15 a. m. and 9:15 a. m. the water in Thunder Bay River fell about three feet; The barometer during this time was stationary; about 9:15 a. m. the water began to rise, and in a few minutes had about reached its normal level; at Puck's Mill work was suspended for about an hour on account of the low water.

Port Huron, Mich., 17th.—Slight change in temperature; light variable winds; dense fog began 1 a. m.; ended 7 a. m.; westerly information signal hoisted 5:35 p. m.

18th.—Thunderstorm; first heard, 1:12 a. m.; loudest, 2:19 a. m.; last, 3:55 a. m.; storm came from the west and moved toward the east; temperature before and after the storm unknown; direction of the wind before the storm, southeast; after, southeast; light rain began 1:38 a. m., with heavy rain from 1:50 a. m. till 3 a. m.; gale of 32 miles southwest at 2:08 a. m.; the thunder and lightning were almost continuous during the entire storm.

Detroit, Mich., 17th.—Dense fog prevailed from early morning until 8:10 a. m.; morning cool, but the day was quite warm; falling barometer with light to fresh westerly winds going to easterly at 2 p. m.; distant lightning was first seen at 8:27 p. m.; three peals of thunder were heard; first, 9:10 p. m.; last, 9:20 p. m.; light rain from 9:17 p. m. to 9:40 p. m.; storm moved from west to east; temperature before, 65°; after, 65°; wind direction before, northeast; after, southeast.

18th.—Falling barometer with much higher temperature; brisk to high westerly winds going to fresh northeasterly after 8 p. m.; a light shower fell from 3:25 a. m. to 3:50 a. m.; it was accompanied by a gale which began at 1:36 a. m., reaching a maximum of 32 miles southwest at 2:39 a. m., ending at 3:50 a. m.; a second gale began at 8:45 a. m., ending at 2:02 p. m.; maximum velocity 32 miles west at 9:49 a. m.; at 9:45 a. m. a westerly information signal was hoisted and was lowered at sunset; rising barometer during the evening and rapidly falling temperature; evening clear.

Toledo, Ohio, 17th.—Clear day; falling barometer; warmer; light to brisk west winds, becoming variable; thunderstorm moving from west to east, with very sharp and frequent lightning; first heard, 8:30; loudest, 9:15; last, 11:10 p. m.; temperature before, 73°; during, 67°; after, 73°; wind before, southeast; during, southeast, west, southwest; after, southwest; rain began 8:58; ended, 11:40 p. m.; amount, .28 inch.

18th.—Clear day and night, falling, followed by rising barometer; continued warm; brisk to high winds, southwest shifting to northwest; maximum velocity 29 miles northwest at 10 a. m.

Sandusky, Ohio, 17th.—Weather clear and slightly cooler, with light

to fresh westerly winds; light rain began 10:16 p. m., ended 11:10 p. m.; amount, .11 inch; thunderstorm; first heard, 10:20 p. m.; loudest, 11 p. m.; last, 11:06 p. m.; storm moved from northwest to southeast.

18th.—Weather clear and warmer; westerly winds, becoming high at 9:45 a. m., decreasing to light late in p. m.

Indianapolis, Ind., 17th.—Warm, clear in the forenoon; partly cloudy in the afternoon; near sunset, threatening clouds in the west; at 7 p. m. noted lightning southwest; heard first thunder at 7:07 p. m., loudest, 7:15 p. m., and last at 7:54 p. m.; light rain from 7:20 p. m. to 7:40 p. m.; frequent flashes of lightning followed by distant thunder; the storm moved from northwest to southeast; no change in temperature; wind, light south preceding; northwest during, and south after the storm; clear evening.

Columbus, Ohio, 17th.—Cloudy in the morning, clearing during the forenoon; a slight sprinkle of rain began and ended during the night of the 16th and 17th; rainfall 8 p. m. [16th] to 8 p. m. [17th], trace.

18th.—Clear weather and rapidly rising temperature in the morning; fresh to brisk southwesterly wind during the day, falling to light in the evening; thunderstorm; first heard at 3 a. m.; loudest, 3:20 a. m.; last, 4 a. m.; temperature before the storm, 68°; after, continued to rise; direction of the wind before the storm, south; after, southwest; light rain began and ended during the night of the 17th and 18th; rainfall, 8 p. m. to 8 p. m., 0.04 inch.

Cleveland, Ohio, 17th.—Slightly warmer, followed by slightly cooler; generally clear weather, followed at night by increasing cloudiness with a trace of rain during the night, and light rain beginning at 10:30 p. m. and continuing; slightly lower temperature; light to fresh south winds, veering to southeast, generally southwest, increasing in force after 11 p. m.

18th.—Northwest signals hoisted by local forecast official at 9:50 a. m.; following received at 11 a. m.: "Hoist southwest signals 10:20 a. m. at Cleveland, Erie, Buffalo, and on Lake Ontario; storm central over Lake Huron, moving east." Telegram calling for 1 p. m. special received at 12:52 p. m.; observation taken on time, filed 1:20 p. m.; much warmer and unusually close, muggy, generally clear weather; much lower barometer; high southeast winds veering to northeast, generally southwest, with storm velocity from 2:03 a. m. to 1:41 p. m.; a gale from 4:20 a. m. to 5:05 a. m., with a maximum of 40 miles southwest at 5:02 a. m., decreasing in force after 2 p. m.

Erie, Pa., 17th.—Partly cloudy, warm, and pleasant.

18th.—A thunderstorm raged from 1 to 3 a. m., accompanied by lightning and rain; during the storm the wind reached 28 miles from the west; the thunder claps were unusually loud and the lightning flashes terrific; it was a most severe storm and extended over a large portion of western Pennsylvania; horses were killed and trees blown down, but no loss of life reported. Amount of rainfall, .54 of an inch; cloudy and threatening, warm and depressing; clear at night.

Buffalo, N. Y., 17th.—Partly cloudy day, quite warm in daytime, with some threatening clouds at sunset; westerly winds fresh to brisk becoming northeast in evening.

18th.—Partly cloudy day, being cloudy with heavy rain in morning and light local rains during day, cooler; variable winds fresh and brisk at intervals when from the westward; thunderstorm moved from southwest to northeast; first thunder heard, 3:10 a. m.; loudest, 3:20 a. m.; and last, 4:15 a. m.; wind before, northeast; during, northeast-east; after, southeast; the temperature fell from 58° to 52°; up storm southwest signals at 9:15 by order of local forecast official, and order confirmed by Chief of Weather Bureau at 11:37 a. m., and down at 10:25 p. m.; no high winds during display, but threatening conditions on a. m. map demanded same.

Rochester, N. Y., 17th.—Very heavy dewfall in morning; measurement in gauge, 0.01 inch; mostly clear, slightly warmer, southwest to northwest fresh and brisk winds.

18th.—Light rain 1:15 to 1:25 a. m.; thunderstorm; first heard, 2:50; loudest, 3:20; last, 4:10 a. m.; moved from south to north; light rain 2:20 to 5:40 a. m.; temperature and wind direction before storm 63°, northwest; after, 56°, southeast; thunderstorm; first heard, 10:24; loudest, 10:32; last, 10:40 a. m.; moved from west to east; light rain 10:20 to 11:40 a. m.; temperature and wind direction before storm 56°, southeast; after, 59°, north; light rain 7:10 to 8:15 p. m.

Albany, N. Y., 17th.—Warmer, pleasant day; scattered clouds in the afternoon, principally cirro-cumulus, moving from the west; low percentage of humidity at the evening observation; character of day, 2, clear.

18th.—Light rain during night (17-18th) to 10:00 a. m.; 3:03 p. m. to 3:17 p. m. and 6:30 p. m. to 7:30 p. m.; weather threatening, with considerable amount of rapidly-moving scud; special observations taken at 10:35 a. m. and 1:00 p. m.

New York, N. Y., 17th.—Light haze in morning; light fog from 7 p. m. to 9 p. m.; clear day.

18th.—Evidence of tornadic action was observed in the east of station between 9:10 a. m. and 9:20 a. m.; there was a bank of dark clouds in great confusion moving apparently from the south; distinct formation could not be fully observed on account of the dense fog at the time; beginning at 9:05 a. m. the barometer fell .2 inch in fifteen minutes; the wind shifted from southeast to south and increased from 8 to 48 miles an hour; the temperature fell about 3°; at 9:30 a. m. the wind backed to southeast then to northeast and to north; the barometer rose

as quickly as it fell, making almost a perfect V on the barograph sheet; no damage was reported in this neighborhood; distant lightning observed in the east from 8 p. m. to 9 p. m.; light fog from 6 a. m. to 9 a. m.; dense fog from 9 a. m. to 10:10 a. m., then light from 10:10 a. m. to 5 p. m.; light rain began 7:25 a. m. and ended at 9:45 a. m.; light rain began 2:20 p. m.; ended 2:35 p. m.; southwest signals hoisted 10:35 a. m.; lowered 6:30 p. m.; partly cloudy day.

Philadelphia, Pa., 17th.—Partly cloudy and warmer; evening clear.

18th.—Light fog from about 4 a. m. to 9:30 a. m.; morning cloudy; light rain began 7:10 a. m., increasing to brisk shower after 8 a. m., and ending 9:50 a. m.; marked barometric fluctuations between 9 and 10 a. m.; barometer fell .15 inch in about forty-five minutes, and then rose sharply .05, followed by a very slight and gradual fall; the wind increased to 33 miles for a short time just before 10 a. m., and afterwards continued very brisk all day; special observation taken at 10:10 a. m.; day mostly cloudy with sunshine during middle portion.

* * * Evening clear until about 10 p. m. when the sky clouded over for a short time with a sprinkle of rain at 10:06 p. m.; thunderstorm; first thunder heard at 10:06 p. m., loudest, 10:10, and last heard 10:20 p. m.; the storm came from the west and moved toward the east; temperature before storm, 75°; after, 74°; direction of wind before, southwest; after, southwest.

Harrisburg, Pa., 17th.—Day warmer and cloudy throughout; light showers at intervals; during forenoon light westerly winds prevailed.

18th.—Day opened with thunderstorm; first thunder, 7 a. m.; loudest, 7:40 a. m.; last heard, 7:15 p. m.; moved from west to southeast; temperature before, 63°; after, 80°; wind before, west; after, south; no hail; clearing and warmer during afternoon; distant lightning during evening.

Baltimore, Md., 18th.—Cloudy, with light fog in the early morning; light rain began at 8:20 a. m., followed by a thunderstorm; first heard, 9:15 a. m.; loudest, 9:40 a. m.; last, 11:10 a. m.; storm came from the northwest and moved toward the southeast; temperature before the storm, 72°; after, 69°; rain ended at 11 a. m., followed by partly cloudy and clear weather; total rainfall for day, 0.25 inch; slightly warmer; light, brisk, and fresh southwest winds.

Washington, D. C., 18th.—Partly cloudy; thunderstorm; first thunder, 9:40 a. m.; loudest, 10 a. m.; last, 10:55 a. m.; storm moved from north to south; temperature before, 73°; after, 67°; direction of wind before, south; after, south; wind, 24 miles from north during storm; rain, 8:40 a. m. to 11:20 a. m.; cleared at noon; cloudy and partly cloudy during the evening; lightning northwest to north; clearing at 10 a. m.

New Haven, Conn., 17th.—Clear until 1:20 p. m.; partly cloudy remainder of the day; much clearer.

18th.—Cloudy day; light fog prevailed from 9:20 a. m. to 5:40 p. m.; light rain from 7:10 a. m. to 10:05 a. m., and from 9:22 p. m. to 9:27 p. m.

New London, Conn., 17th.—Clear and pleasant, slightly warmer; light, westerly winds.

18th.—Cloudy and threatening until 7:30 p. m., when it became clear and continued remainder of day; rain began 8:06 a. m. and ended 10:41 a. m.; began again 6:06 p. m. and ended 6:32 p. m.; amount for day, 0.17 inch; light, variable winds.

Block Island, R. I., 17th.—Clear and pleasant, decreasing pressure, fresh, southwest winds.

18th.—Slightly warmer; light rain began at 10:10 a. m. and ended at 11:15 a. m.; light, variable winds.

Nantucket, Mass., 17th.—Slowly falling barometer, rising temperature; light, westerly winds; light rain began and ended during night; amount, 0.01 inch; dense fog set in at 7 p. m.

18th.—Cloudy weather; light rain began 10:10 a. m.; southwest signal received 11:35 a. m.; rain ended 2:35 p. m.; amount, 0.06; gentle, becoming fresh, southeast winds shifting to northwest in evening; barometer fell rapidly in late a. m.

Boston, Mass., 17th.—Light clouds gathered before noon, at which hour a large, well-defined solar halo became visible; the clouds passed away at sunset, but returned shortly after the evening observation; the feature was the marked increase in temperature, the latter advancing 16° above the highest figure of yesterday, making the day seem very warm in contrast; west to southwest winds, brisk in the afternoon.

18th.—Threatening clouds in the early part of the morning turned to a light, drizzling rain which lasted till about 1 p. m., with cloudy skies throughout the remainder of the day; the prevailing north to east winds brought a low temperature, and the air was chilly and disagreeable; southwest signals ordered on Newport section in the morning, and information signals at Boston and section; special observations taken at 10:40 a. m. and 1 p. m.

LOCAL ATMOSPHERIC DISTURBANCES.

By A. J. HENRY.

In addition to the local thunderstorms, tornadoes, and hailstorms and such local phenomena as chinook winds, and diurnal land and sea breezes, there are still other disturbances less conspicuous to the eye and which might be thought to be purely local phenomena if we had not records from enough stations to show that they have a very general aspect. The